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Method of delivery of low birthweight infants. A retrospective analysis

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1 Introduction

The safe delivery of the low birthweight infant poses a major problem to obstricians everywhere. One aspect of this problem is the method of delivery. Many authors recommend systematic cesarian section for the very preterm breech baby [1, 4, 5, 8, 9, 10, 12] and for preterm twins [13] but there are no general consensus on how to deliver the low birthweight infant in the vertex presentation.

In our department the tendency over the years has been to widen the indications for delivery by cesarian section. The purpose of this retrospective analysis was to detect any difference in outcome for low birthweight infants born during the period of transition toward extended use of cesarian section in preterm delivery.

2 Material and methods

The birth registers of the obstetric department YA for 1978 and 1979 were screened. Clinical records of babies with birthweight 501 to 2500 gram were examined including the CTG-recordings and the records from the neonatal intensive care unit. Information on treatment up to final discharge was collected for infants discharged to other hospitals.

During the period under study, the routine management of labor prior to the 27th week of gestation was conservative. The routine medical treatment of preterm labor was beta-mimetics and phenobarbitone, until 35 weeks of gestation beta-metazone was also given. In case of twin-pregnancy or breech presentation the routine was cesarian section. In the absence of these complications or obstetric emergency the method of delivery depended on the preferences of the attending physician.

General anestesia was used routinely for cesarian section including barbiturates for induction and at times including early use of halotane for uterine relaxation during fetal extraction.

Ventilator therapy was not usually initiated during the first day of life in infants below 1000 gram.

3 Classifications

Gestational age (GA) was classified as completed weeks after the last menstruation verified by early ultrasonography where possible.

Method of delivery was classified as vaginal delivery or cesarian section. Further details concerning use of forceps, method of cesarian section (the routine was lower transverse section) and complications were not recorded.

Maternal disease included previous obstetric complications, severe liver-, kidney- or cardiac disease, chronic intestinal disease, endocrine- or mental disease or drug addiction.

Complications of pregnancy included toxemia, severe bleeding, placenta praevia, placental abruption or hydrorrhea for more than 8 days. Twin-pregnancy and fetal presentation other than vertex was also classified here.

Placental insufficiency was diagnosed by signs of intrauterine growth retardation before delivery by estimated fetal weight in the small-for-date weight area, decreased growth rate of BPD or subnormal/decreasing estriol and/or HPL values in maternal serum. Tocolysis was recorded if beta-mimetics and phenobarbitone, the standard treatment of premature labor, had been started.

Intrauterine asphyxia was considered present in case of fetal bradycardia, cardiotocographic signs of fetal asphyxia or meconium stained amniotic fluid.

Neonatal asphyxia was considered present when the APGAR scores were less than 5 at one minute or less than 8 at five minutes.

Intracranial hemorrhage was diagnosed by autopsy or in survivors by a bloody cerebrospinal fluid with the presence of phagocytosis of red blood cells. A few cases were diagnosed by computerized tomography.

Respiratory distress was considered present when the infant required more than 40% oxygen or assisted ventilation.

Intravenous fluid therapy was recorded when more than 50 ml/day (required for i.v. medication) was administred.

To yield a more homogeneous material, in which the method of delivery to chose was particularily in doubt, we defined a subsample (in the following called the reduced material). We excluded 19 infants with severe congenital malformation, 15 infants delivered after rhesus-immunisation in pregnancy, 98 infants delivered after 37 completed weeks, 8 infants delivered before 27 completed weeks, 4 infants with early, severe intrauterine asphyxia as well as 6 infants with incomplete records.

The effect of cesarian section, neonatal asphyxia and gestational age on intracranial hemorrhage and on neonatal mortality was evaluated by multiple regression analysis yielding estimates of the odds ratio. Statistical significance of the odds ratio was tested by the one-tailed t-test.

4 Results

During the two year period 329 infants of birthweight 501 to 2500 gram were born alive and 26 were stillborn. 178 infants were included in the reduced material according to the criterias decribed in the previous section. The distribution according to birthweight appears in Fig. 1. There was a small excess of infants delivered per vaginam in the higher weight groups.

Eighty three infants were delivered by cesarian section. The rate of cesarian section increased from 1978 to 1979, so did the rate of placental insufficiency and complications of pregnancy (Tab. I). 13 infants died, all within the first 28 days of life.

The infants delivered by cesarian section were compared to the infants delivered per vaginam (Tab. II). The gestational age was identical, 33 weeks. The birth weight was slightly lower in the

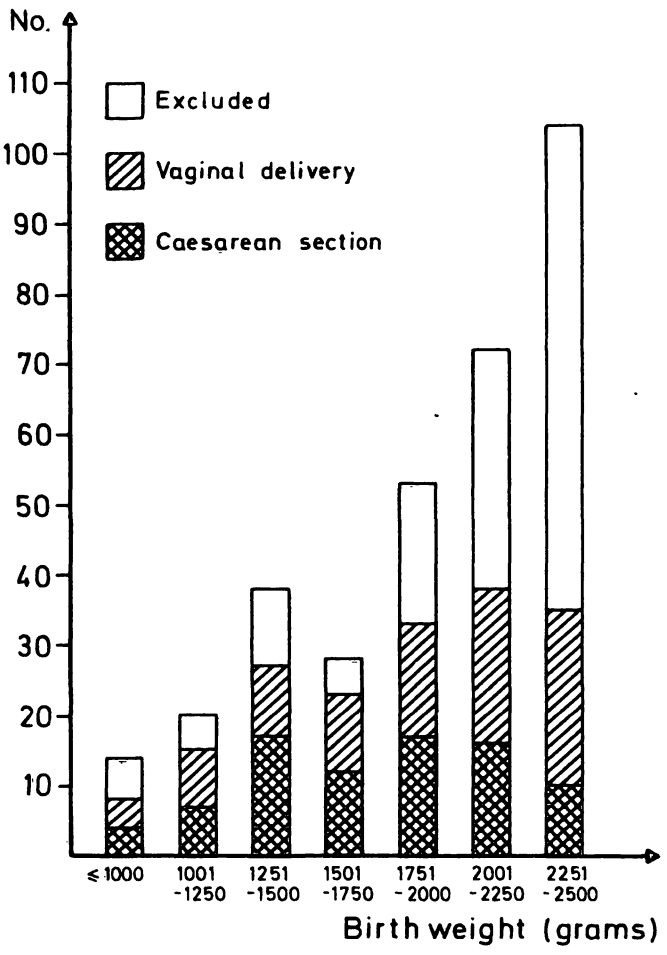

Fig. 1. Method of delivery in relation to birth weight.

Tab. I. Data on method of delivery, pregnancy and neonatal period according to year of study.

	1978	1979
Number of infants	90	88
Cesarian sectio	33	50
Maternal disease	15	19
Complications of pregnancy	39	54
Placental insufficiency	11	27
Mean birthweight	1830 g	1790 g
Small-for-date	18	21
Infants below 1000 g	5	3
Neonatal deaths	11	2
Intracranial hemorrhage	8	9

infants delivered by cesarian section, 1744 grams compared to 1866 grams. Obstetric complications were more common in the cesarian section group as was the rate of elective delivery as well as unsatisfactory clinical condition at birth and at 2 days and at 5 days of age. The use of tocolysis was comparable, the majority receiving beta-mimetics, phenobarbitone and betametazone.

Contrary to this, the rate of intracranial hemorrhage and mortality tended to be lower. In order to examine this further, including the effects of other factors influencing outcome, multiple regression was carried out (see Appendix 1). Cesarian section appeared to reduce the risk of intracranial hemorrhage (odds ratio = 0.36, $p < 0.1$) while the neonatal mortality tended to be lower, although this was even less statistically significant (odds ratio = 0.65, $p < 0.2$).

Tab. II. Data on pregnancy and neonatal period according to method of delivery.

	Vaginal	Cesarian
No. of infants	95	83
Mean birthweight	1866 gram	1744 gram
Mean gestational age	33.0 weeks	33.0 weeks
Small-for-date	14	25
Maternal disease	12	22
Complications of pregnancy	29	64
Placental insufficiency	4	34
No tocolysis	24	30
Elective delivery	6	20
Intra-uterine asphyxia	15	22
Neonatal asphyxia	12	18
Neonatal death	8	5
Intracranial hemorrhage	11 (5 dead)	6 (4 dead)
Survivors	87	78
2. day: respiratory distress	22	30
i.v. fluids	32	44
5. day: respiratory distress	7	17
i.v. fluids	20	28
Mean age at discharge	30.5 days	35.7 days

5 Discussion

The low birthweight infant delivered prematurely runs a one-in-ten risk of neonatal death and a one-in-ten risk of permanent neurological or developmental deficit due to perinatal insult [3, 18]. It is of great interest to know if these risks can be reduced by cesarian section.

What risks can be imposed on the mother for the sake of her premature fetus? The question has become more important since the advent of neonatal intensive care and the improved chances of survival of the premature infant. Prevention of permanent handicap is even more important than reducing neonatal mortality. It can be argued that the risks to the premature fetus is of a higher order of magnitude than the risks to the mother from an abdominal delivery. This is the case at least in Denmark where it is unusual for a woman to give birth more than twice or three times and where antenatal services and delivery services are highly organized. In a different setting, where multiple births are common it is possible that the risks to the mother and the fetuses of future pregnancies are very real [15]. In such case the advantages of cesarian section for delivery of the premature infant needs to be very well established.

Conclusions from a retrospective study as the present one should be drawn with caution, but in the available material it appears that the risk of intracranial hemorrhage was reduced to less than half after cesarian section. If such a reduction could be achieved by cesarian section it would be of great importance. Even the estimated effect of cesarian section on neonatal mortality points to great potential benefits.

A number of retrospective studies have been published, most favoring cesarian section [1, 5, 8, 9, 10, 12], but not all [2]. All suffer from the same

methodological constraints as the present study: A limited number of infants and doubtful comparability.

In any single institution the number of premature infants delivered is limited. In view of the rapid changes in perinatology, as exemplified in Tab. I, it is in general not possible to extend the period of analysis to more than a few years. To include more than one institution in a study may be hazardous if both the rate of cesarian section and the outcome differ between the institutions due to external factors.

No retrospective analysis can be certain to avoid bias. A general way of reducing the influence of differences in composition of the compared groups by extensive use of multivariate analysis requires rather higher numbers than are available. To make the material more homogeneous we used rather strict criterias of exclusion. Thus, rhesus-immunisation, and early, severe intrauterine asphyxia were always delivered by cesarian section while the immatures (gestational age < 27 weeks) were usually delivered per vaginam and were therefore excluded. Nevertheless significant differences between the two groups of infants are apparent in Tab. II. The infants delivered by cesarian section were delivered after more obstetric complications, more often delivered electively, were slightly lighter and the clinical condition in the neonatal period was less satisfactory. While the increased risk of respiratory distress after cesarian section is likely to be a direct effect [7], it is uncertain whether the greater need for intravenous fluids was also a direct result of the cesarian section or rather a result of the lower birthweight.

Neonatal asphyxia, as expressed by APGAR scores, tended to be more common in the infants delivered by cesarian section, which was also found by PAUL and SMITH [14, 17]. This is somewhat unexpected as the main objective of cesarian section in premature delivery is to minimize the perinatal insult by minimizing anoxia and physical trauma. Three factors could be involved. Partly, the general anestesia is likely to depress the labile cardio-respoiratory function of the premature infant. Partly, intrauterine asphyxia tended to be more common in the infants delivered by cesarian section. Finally, the low transverse incision may not be optimal for delivery of the very small infant [6]. Unfortunately umbilical artery pH was only measured in about 20% of the infants.

A randomized, controlled study would be most useful. 400 infants would be required to demonstrate a reduction in mortality from 10% to 5%. Less infants would be required to demonstrate a reduction in intracranial hemorrhage, detected by ultrasound, but the prognostic significance of the small sub-ependymal hemorrhages, which constitute more than half of the total number of hemorrhages, is still debated [11, 16]. Furthermore carrying out a randomization procedure in the swiftly changing clinical setting of premature labor and delivery would be very demanding if not impossible.

In conclusion, it is unlikely that solid proof of the benefits of cesarian section for delivery of the premature infant will come forward soon. We find that the available evidence points to liberal use of cesarian section in premature labor, regardless of fetal presentation.

6 Appendix 1

The effect of method of delivery was studied by means of logistic, multiple regression, which is required when the dependent variable is assumed to follow the binomial distribution. This method of statistical analysis puts no restrictions on the distributions of the independent variables. Intracranial hemorrhage and neonatal death were used as dependent variables. The result of the analysis is a set of odds ratios expressing the changes in risk of unfavorable outcome depending on each independent variable. When the risks are low as in the present case the odds ratios approach the relative risks.

Tab. III. Factors predicting intracranial hemorrhage. 5 factors in multiple regression.

	Odds ratio	p
Higher gestational age (per week)	0.58	< 0.001
Small-for-date	7.9	< 0.001
Intrauterine asphyxia	1.06	> 0.2
Complications of pregnancy	0.95	> 0.2
Cesarian section	0.36	< 0.1

The result of the analysis of factors contributing to intracranial hemorrhage appears in Tab. III. As expected the risk of intracranial hemorrhage decreased with increasing gestational age. Unexpectedly the small-for-date infant had a considerably increased risk of intracranial hemorrhage. Finally, infants delivered by cesarian section tended to have smaller risk of intracranial hemorrhage than did the infants delivered vaginally. Neither intrauterine asphyxia nor complications of pregnancy did appear to have any effect on outcome. The exclusion of these two factors from the analysis did not significantly reduce the goodness of fit of the model and it did not change the odds ratios significantly.

In order to see if the benefits from cesarian section was more significant in the lower gestational age range we included a factor of interaction between the method of delivery and gestational age in the analysis. The interaction was not statistically significant while the tendency was towards greater benefits in the high gestational age range. This means that the presented data do not point to any upper gestional age limit at which cesarian section is useful.

Tab. IV. Factors predicting neonatal death. 5 factors in multiple regression.

	Odds ratio	p
Higher gestational age (per week)	0.54	< 0.001
Small-for-date	20.3	< 0.001
Intrauterine asphyxia	0.67	< 0.2
Complications of pregnancy	0.95	> 0.2
Cesarian section	0.65	< 0.2

The analysis of factors contributing to neonatal death appears in Tab. IV. The odds ratio of cesarian sectio was considerably below unity but did not reach statistical significance. After exclusion of the two other insignificant factors the odds ratio declined but did still not reach statistical significance.

The increased risk of intracranial hemorrhage and neonatal death in small-for-date infants deserves special mention. It reflects the effect of birthweight when gestational age is held constant. The calculated effect of the small-for-date factor may have been increased by the lack of small-for-date infants in the high weight range due to the selection criteria of $\leqslant 36$ weeks. The exclusion of the small-for-date factor did not significantly affect the estimated effect of cesarian section.

Summary

The method of delivery is an important aspect of the management of preterm labor. We present a retrospective analysis of obstetric and neonatal factors in 355 consecutive infants with birthweight $\leqslant 2500$ g. Stillborn infants, infants with severe congenital malformations or rhesus immunization, infants delivered at term or born before 27 completed weeks of gestation and infants with severe, early intrauterine asphyxia were excluded. 178 infants remained for analysis.

During the two-year period under study, 1978–79, the routine perinatal management of immature infants (gestation < 27 weeks) was conservative. In case of preterm breech or twin-pregnancy the routine was cesarian section. General anestesia was used routinely for cesarian section.

The rate of cesarian section increased in the second year, so did the rate of placental insufficiency and complications of pregnancy (Tab. I).

Mean birthweight was 1800 g and mean gestational age was 33 weeks.

Obstetric complications and unsatisfactory clinical condition of the infant in the neonatal period were more common in the cesarian section group. Elective delivery was more common in this group. The birthweight was also slightly lower and there were more small-for-date infants (Tab. II).

The rate of intracranial hemorrhage tended to be lower after cesarian section. Eleven of the 95 infants delivered vaginally sustained a neonatal intracranial hemorrhage while only 6 of the 83 infants delived by cesarian section did so. **Multiple regression showed the risk of intracranial hemorrhage to be reduced to less than half after cesarian section** (odds ratio = 0.36, $p < 0.1$). If this reduction holds true it would be of great clinical importance.

An effect of cesarian section on neonatal mortality could not be demonstrated although the estimate of the risk of neonatal death after cesarian section was reduced by a third (odds ratio = 0.65, $p < 0.2$).

The methodological problems of aquiring firm evidence of the benefits of cesarian section are discussed and it is argued that few institutions will deliver sufficient numbers of low birthweight infants to allow the comparison of very narrowly defined subgroups. On the other hand a randomized, controlled study can be considered impractical.

In our situation the risks to the preterm fetus is of a higher order of magnitude than the risks to the mother from an abdominal delivery. **Our results would indicate that there are good chances to achieve major benefits by liberal use of cesarian section, regardless of fetal presentation.**

Keywords: Cesarian section, intracranial hemorrhage, low birthweight, neonatal mortality, preterm delivery.

Zusammenfassung

Geburtsmethoden bei untergewichtigen Kindern: Eine retrospektive Analyse

Ein wichtiger Aspekt für die Geburtsleitung bei vorzeitigen Entbindungen ist die Geburtsmethode. In einer retrospektiven Studie untersuchten wir geburtshilfliche und neonatale Parameter bei 355 nacheinander entbundenen Kindern mit einem Geburtsgewicht ≤ 2500 g. Nicht einbezogen wurden Totgeburten, Kinder mit schweren kongenitalen Mißbildungen oder Rhesussensibilisierung, Kinder, die am Termin oder vor Vollendung der 27. Schwangerschaftswoche entbunden wurden sowie Kinder mit einer früh einsetzenden intrauterinen Asphyxie, so daß das Kollektiv schließlich aus 178 Kindern bestand.

Während des zweijährigen Beobachtungszeitraumes 1978 bis 1979 wurde bei unreifen Kindern (Schwangerschaftsdauer < 27 Wochen) konservativ vorgegangen. Bei Steißlagen oder Zwillingsgeburten wurde routinemäßig eine Sectio in Vollnarkose durchgeführt.

Im zweiten Jahr stieg die Anzahl der Sectiones; auch die Plazentainsuffizienz sowie Komplikationen während der Schwangerschaft wurden häufiger registriert (Tab. I).

Das durchschnittliche Geburtsgewicht lag bei 1800 g, die mittlere Schwangerschaftsdauer betrug 33 Wochen.

Geburtshilfliche Komplikationen und unbefriedigende klinische Befunde in der Neonatalphase waren in der Sectio-Gruppe häufiger. Auch wurden häufiger elektive Entbindungen durchgeführt. Das Geburtsgewicht war etwas niedriger, und es gab mehr Small-for-date-Kinder (Tab. II).

In der Tendenz traten inracranielle Blutungen nach Sectiones nicht so häufig auf. 11 der 95 vaginal entbundenen Kinder entwickelten eine intracranielle Blutung. Bei den per Sectio entbundenen Kindern waren es nur 6 von 83. **Die multiple Regressionsanalyse zeigt, daß das Risiko einer intracraniellen Blutung nach Sectio auf weniger als die Hälfte sinkt** (odds ratio = 0,36, $p < 0,1$). Die Bestätigung dieses Ergebnisses wäre von großer klinischer Bedeutung.

Wir konnten nicht zeigen, daß eine Sectio die neonatale Mortalität beeinflußt. Nach unserer Einschätzung ist aber das Risiko, nach einer Sectio in der Neonatalphase zu sterben, auf ein Drittel reduziert (Odds ratio = 0,65, $p < 0,2$).

Es werden die methodologischen Probleme, die auftauchen, wenn man die Vorteile der Sectio letztlich beweisen will, diskutiert. So glauben wir, daß nur in wenigen Institutionen eine genügend große Anzahl von untergewichtigen Kindern entbunden wird, so daß ein Vergleich von sehr eng umschriebenen Untergruppen möglich ist. Auf der anderen Seite ist eine randomisierte kontrollierte Studie praktisch nicht durchführbar.

In unserer Situation ist das Risiko bei vorzeitigen Entbindungen beim Kind höher zu bewerten als das Risiko der Mutter durch eine abdominelle Schnittentbindung. **Unsere Ergebnisse deuten an, daß eine liberale Handhabung der Sectio größere Vorteile bietet, unabhängig vom fetalen Zustand.**

Schlüsselwörter: Intracranielle Blutung, neonatale Mortalität, niedriges Geburtsgewicht, Sectio caesarea, vorzeitige Entbindung.

Résumé

Mode d'accouchement des enfants de faible poids de naissançe: Une analyse rétrospective

Le mode d'accouchement est un aspect important de la prise en charge de l'accouchement prématuré. Les auteurs présentent une analyse rétrospective d'éléments obstétricaux et néo-nataux chez 355 enfants consécutifs de poids de naissances ≤ 2500 g. Ont été exclus les mort-nés, les enfants porteurs de graves malformations congénitales ou avec une immunisation rhésus, les enfants nés à terme ou avant la fine de la 27ème semaine de gestation, ainsi que les enfants ayant subi une asphyxie intrautérine précoce et majeure. Il reste 178 enfants pour l'étude.

Pendant la période des 2 années de l'étude, 1978–1979, l'attitude périnatale de routine face aux enfants immatures (27 semaines de gestation) a été conservatrice. En cas de présentation du siège prématurée ou de gémellaire, l'extraction par césarienne était la routine. L'anesthésie générale était habituellement pratiquée pour les césariennes.

Le taux de césarienne a augmenté au cours de la seconde année de même que le pourcentage d'insuffisance placentaire et que les complications de la grossesse (Tab. I).

Le poids de naissance moyen est de 1800 g et l'âge gestationnel moyen de 33 semaines.

Dans le groupe des césariennes, les complications obstétricales et les états cliniques peu favorables en période néonatale ont été plus fréquents. L'accouchement électif est plus habituel dans ce groupe. Le poids de naissance est également légèrement inférieur et il y a plus d'enfants hypotrophiques (Tab. II).

Le taux d'hémorragie intracranienne tend à diminuer après césarienne. 11 des 95 enfants nés par voie basse ont présenté une hémorragie intracranienne néonatale, contre seulement 6 des 83 enfants nés par césarienne. **Le risque d'hémorragie intracranienne est diminué de plus de moitié après césarienne** (rapport = 0,36, $p < 0,1$). Si cette réduction persiste, elle sera de grande importance clinique.

On ne peut démontrer un effet de la césarienne sur la mortalité néonatale bien que l'estimation du risque de mort néonatale après césarienne soit diminué d'un tiers (rapport = 0,65, $p < 0,2$).

Les auteurs discutent les problèmes méthodologiques nécessaire pour affirmer les bénéfices de la césarienne et ils reconnaissent que peu de services donnent naissance à un nombre suffisant d'enfants de faible poids pour être

autorisés à effectuer des comparaisons de sous-groupes très voisins. Par ailleurs, une étude contrôlée, randomisée n'est pas réalisable.
Dans la situation actuelle, les risques pour le foetus prématuré sont d'un niveau plus élevé que les risques encourus par la mère du fait d'une césarienne. **Les resultats des auteurs sembleraient indiquer qu'il y a de bonnes chances de tirer un bénéfice important en réalisant de façon libérale des césariennes quelle que soit la presentation foetale.**

Mots-clés: Accouchement prématuré, césarienne, faible poids de naissance, hémorragie intracranienne, mortalité néonatale.

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